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Application No.: 10/701,836

CERTIFICATION

I, the below named translator, hereby declare that: my name and post office address are as stated below; that I am knowledgeable in the English and German languages, and that I believe that the attached text is a true and complete translation of the application filed in German on November 5, 2003, now prosecuted at the PTO under application No. 10/701,836.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Description

Support part with fixing pin

The invention relates to a support part having at least one locating hole in which a fixing pin is captively arranged. In this case, the term "support part" refers to an intermediate support of small thickness, in particular a gasket, e.g. a cylinder head gasket.

When fitting such a support part in the form of a cylinder head gasket for example, it is often necessary to fix this support part, effective as an intermediate support, to a substructure in the form of a mounting part, e.g. a cylinder head or block. Such fixing is necessary in particular when, during the attachment of a further mounting part, e.g. of a cover or an intake manifold, there is the risk of a transverse displacement of the support part relative to this or these mounting parts. Such fixing is virtually essential when fitting at obliquely running joints or sealing faces of the mounting parts to be joined.

In particular in the case of a support part made of plastic, fixing pins are integrally extruded on the support plate for this purpose. Such a support part in the form of a single-layer sheet-metal gasket with securing elements integrally formed in one piece has been disclosed by DE 100 13 130 A1. The securing elements, which in the fitted state in each case pass through a drill hole of a machine component in the form of an intake manifold flange, engage behind the opening edge of the corresponding drill hole by means of their projections provided for this purpose at the free end, so that the metal gasket, on account of its one-piece connection with the securing elements, is held on the flange-like machine component.

In a cylinder head gasket for piston engines which is disclosed by DE 33 21 425 A1, the cylinder head gasket is fixed in position relative to a cylinder block by fixing

bushes which are firmly connected by means of upset or beaded edges to the plate forming the cylinder head gasket. In the fitted state, the fixing bushes engage with friction grip in corresponding blind holes of a cylinder block.

The object of the invention is to specify an especially suitable support part having fixing pins.

This object is achieved according to the invention by the features of claim 1. To this end, the fixing pin has a bottom insertion section and a center shank section and also a top retaining section with a number of retaining teeth of different length. In the fitted state, the or each comparatively long retaining tooth overlaps an associated hole edge of the locating hole of the support part at the top, whereas the or each comparatively short retaining tooth, at the opposite underside of the hole edge, undercuts or engages behind the latter. This is achieved in that the outside or circumferential diameter of the fixing pin in the end region of the comparatively short retaining teeth is greater than the hole diameter of the locating hole.

According to an expedient configuration of the fixing pin, its comparatively long retaining teeth are angled outward at the end. The respective comparatively short retaining tooth can be angled outward or inward at the end. This angled configuration at the end of the comparatively short retaining teeth permits a reliable captive retention of the fixing pin inside the locating hole and thus on the support part. For this purpose, the short retaining teeth with angled tooth ends, after insertion of the fixing pin into the locating hole, assigned to the latter, of the support part, e.g. by a pressing operation, are bent out to such an extent that the undercut is produced up to the hole bearing surface on the underside on the hole edge of the locating hole.

The fixing pins are expediently fixed in the locating holes assigned to them by means of a snap connection. To this end,

the retaining teeth of the fixing pin are advantageously bent at least slightly outward and are at the same time elastic. As a result of the comparatively short retaining teeth being bent outward, the circumferential diameter of the fixing pin at the free end of the comparatively short retaining teeth is greater than the hole diameter of the locating hole.

In the embodiment variant with subsequent bending-out of the short retaining teeth, the fixing of the fixing pin is achieved by lasting or permanent deformation.

The center shaft section of the fixing pin, this center shaft section adjoining the top retaining section having the retaining teeth of different length, is expediently cylindrical in cross section.

The insertion section, over its section length in the axial direction of the fixing pin, has at least one recess, preferably a plurality of recesses, with push-in arms being formed. In this way, the insertion section of the fixing pin is designed to be elastic in a simple and reliable manner. In addition, the insertion section, at the end, has a bevel directed inward. This bevel serves as an aid for inserting the fixing pin into a mounting hole of a mounting part, e.g. of a cylinder head, on the sealing face of which the support part having the integrated fixing pin is fitted. In addition, the fitting is in this case facilitated by the elastic configuration of the insertion section. As a result, the fitting is possible in a simple and reliable manner even in the case of a production-related center offset between the locating hole of the support part and a corresponding hole in the mounting part, also referred to below as machine part.

The fixing pin is locally enlarged with regard to its outside diameter. This is expediently achieved by a prominence which is provided on the circumference of the fixing pin and is in particular in the form of local bulges or integrally formed warts. These expediently only local enlargements in diameter

are advantageously arranged in that region of the insertion section which adjoins the center shank region, in particular between the center shank section and the bevel, directed inward, of the insertion section. Especially firm seating of the fixing pin in the drill hole of the machine part is achieved by the local enlargement in diameter.

In order to compensate for a possible center offset between the locating holes, captively retaining the fixing pins, of the support part and the holes, corresponding to said locating holes, in the machine or mounting part, the fixing pin is inserted into the corresponding locating hole of the support part with a certain radial clearance. In this case, the desired firm seating of the fixing pin in the support part is achieved by the comparatively long retaining teeth being designed to be elastic and by being bent or angled by a corresponding oversize relative to the shank diameter of the center shank region of the fixing pin. At the same time, the circumferential diameter of the fixing pin along the long retaining teeth, in the prefitting state of the fixing pin, is greater than the hole diameter of the locating hole of the support part.

For a certain axial clearance of the fixing pin, in particular for compensating for production-related tolerances of the thickness or sheet thickness of the support part, the distance or the difference in length between the short and the long retaining teeth is at least slightly greater than the thickness of the support part. The distance is expediently at least as large as the largest possible thickness of the support plate in the region of the locating hole. Firm seating of the fixing pin in the locating hole is then nonetheless ensured, because, on account of the spring action of the long retaining teeth, which spring action is produced as a result of the inclined position of the long teeth or the bending of the long teeth outward, an axial force component is always present, which displaces the fixing pin axially upward against the insertion direction in the locating hole of the support

part, that is to say virtually out of the hole, until the short retaining teeth bear on the underside against the hole edge. The comparatively long retaining teeth are in this case preferably angled symmetrically outward in such a way that they bear against the hole edge of the locating hole. As a result, the fixing pin is held in a centered position in the locating hole virtually automatically.

The fixing pin is expediently designed as a one-piece sleeve. To this end, the fixing pin is preferably produced by rolling a sheet-metal strip with corresponding recessed portions and embossments. The slot or gap remaining when the sheet-metal strip is rolled can in this case be advantageously used for increasing the spring action - and thus during fitting and for compensating for tolerances.

The fixing pin is used in an especially advantageous manner when positioning and/or retaining a support part, in particular a gasket, on a mounting part, in particular a cylinder head of a piston engine. In this case, the top retaining section of the fixing pin accommodates the hole edge of the respective locating hole between its retaining teeth of different length and is thus captively held on said support part. Via the expediently beveled insertion section, which in addition is also advantageously elastic, the fixing pin, with its center shank section, for producing a reliable push-in connection between the support part and the mounting part, can be inserted in an especially easy-to-fit manner into a hole correspondingly provided in said mounting part.

The advantages achieved with the invention consist in particular in the fact that, even in the case of a support part made of metal, e.g. aluminum, the fixing pins can be integrated in said support part in a simple manner and with reliable retention while avoiding integral extrusion, which requires an additional operation. The risk of frequently occurring shearing-off of fixing pins as a result of transverse displacements which occur, for example, when

attaching large or heavy mounting parts is also avoided. The risk of such shearing-off is at least considerably reduced, in particular if the fixing pins are made of a load-bearing material, e.g. sheet steel.

The spring action of the retaining teeth and of the pin shank of the fixing pin, in an especially advantageous manner, achieve the effect that the pin center axis, with at the same time firm seating of the fixing pin in the locating hole of the support part, can follow a hole offset relative to the hole of the mounting part by one long retaining tooth, for example, deviating to the inside toward the pin center axis to a greater extent and by another long retaining tooth deviating instead to the outside to a greater extent.

Exemplary embodiments of the invention are explained in more detail below with reference to a drawing, in which:

Figs 1 and 2 show a fixing pin according to the invention of a support part in a perspective representation or front view,

Fig. 3 shows a section III-III in fig. 2 with a local prominence on an enlarged scale,

Fig. 4 shows a cutaway view of a support part in the form of an intermediate gasket with a fixing pin held in a locating hole,

Fig. 5 shows a cutaway view of a mounting part as a substructure with a hole for accommodating the fixing pin,

Fig. 6 shows the fixing pin retained in the locating hole in a sectional representation,

Fig. 7 shows the support part mounted with the substructure in a sectional representation according to fig. 6,

Fig. 8 shows a detail VIII in fig. 6 on an enlarged scale for illustrating the force relationships at the fixing pin in the hole edge region of the locating hole,

Fig. 9 shows the fixing pin retained in the support part and having short retaining teeth angled outward in a cutaway representation according to fig. 6,

Fig. 10 shows the fixing pin having long retaining teeth angled outward and short retaining teeth angled inward in a representation according to fig. 9, and

Figs 11 and 12 show the fixing pin having a virtually closed ring in the region of the long retaining teeth.

Parts corresponding to one another are provided with the same designations in all the figures.

In figs 4, 6 and 7, the fixing pin 1 shown on its own in figs 1 and 2 is arranged in the form of a clip connection or snap connection in a captive manner in a locating hole 2 of a support part or intermediate support 3. According to fig. 4, the support part 3 has a sealing lip 4 and a perforated spacer 5 which also serves for reinforcement.

The support part 3 is, for example, a cylinder head gasket which, in the fitted state, is put onto a mounting part 6 shown in fig. 5 in the form of, for example, a cylinder head. In this case, a hole 8 having the sealing surface 7 of the mounting part 6 accommodates the fixing pin 1. As a result, the support part 3 rests in position with its sealing surface 9 corresponding to the sealing surface 7 of the mounting part 6 and having the sealing lip 4 and is at the same time securely retained at or on the mounting part 6 by means of the fixing pin 1 - and further fixing pins 1 fixed in corresponding locating holes 2 of the support part 3.

The retention of the support part 3 by means of the fixing pins 1 on the mounting part 6 is effected in this case like a press connection. The support part 3, in the case of a cylinder head gasket, in combination with the fixing pins 1, is an intermediate support between the crankcase 6 and a cylinder head (not shown). The support part 3, with integrated fixing pins 1, may also be an intermediate support of a pipe connection, e.g. of an intake-manifold or flange connection of a machine component.

As can be seen in particular from fig. 2, the fixing pin 1 consists of a top retaining section 1a and of a center shank section 1b adjoining in the pin longitudinal direction 10 and also of an adjoining bottom insertion section 1c. The top retaining section 1a has a number of retaining teeth 12, 13 which extend in the pin longitudinal direction 10 and in the direction of the center longitudinal axis 11 of the fixing pin 1. In this case, comparatively long retaining teeth 12 and, in contrast, comparatively short retaining teeth 13 are provided.

As can be seen comparatively clearly from fig. 1, the retaining teeth 12, 13 are arranged in a uniformly distributed manner at the circumference of the top retaining section 1a of the fixing pin 1, which is sleeve-like overall. In this case, a comparatively short retaining tooth 13 is arranged on both sides of each comparatively long retaining tooth 12, and conversely a comparatively long retaining tooth 12 is arranged on both sides of each comparatively short retaining tooth 13. Overall, therefore, the long retaining teeth 12 and the short retaining teeth 13 are distributed alternately at the circumference of the fixing pin 1 and are preferably arranged equidistantly. In addition, the retaining teeth 12, 13 are bent at least slightly outward and are thus spread out relative to the center shank section 1b and the bottom insertion section 1c with a corresponding increase in diameter - starting from the center shank section 1b up to the free end of the top retaining section 1a.

At the end, the comparatively long retaining teeth 12 are bent approximately at right angles with collar-like lugs 14 being formed. With these retaining lugs 14, the comparatively long retaining teeth 12 of the fixing pin 1 enclose or overlap a hole edge 15 of the support part 3 on the top side at a hole seating surface 15a in the region close to the hole (fig. 6). Thus the fixing pin 1 is already secured against falling out in the pin longitudinal direction 10 inside the locating hole 2 of the support part 3. The fixing pin 1 is further secured inside the locating hole 2 against the pin longitudinal direction 10 by the comparatively short retaining teeth 13. For this purpose, the latter bear against the bottom hole bearing surface 15b, opposite the hole seating surface 15a of the hole edge 15, of the locating hole 2 on the support part 3. The difference L in length (fig. 2) between the comparatively long retaining teeth 12 and the comparatively short retaining teeth 13 corresponds in this case to at least the thickness d of the support part 3 (fig. 6) in the region of the hole edge 15. The comparatively long retaining teeth 12, on the one hand, and the comparatively short retaining teeth 13, on the other hand, therefore accommodate the support part 3 between them in the region of the hole edge 15 of the locating hole 2. As a result, the fixing pin 1 inserted into the respective locating hole 2 is firmly connected to the support part 3 and is captively integrated in the latter.

The embodiment of the fixing pin 1 shown in figs 1 and 2 and also in figs 6 and 7, in its top retaining section 1a, leads to a snap connection between the support part 3 and the fixing pin 1 when the latter is inserted into the respective locating hole 2.

In contrast, in the exemplary embodiments according to figs 9 and 10, the fixing pin 1 is first of all only inserted into the locating hole 2 of the support part 1. In this case, according to fig. 9, the comparatively short retaining teeth 13 are bent outward at their tooth ends 17. In the embodiment variant according to fig. 10, the tooth ends 17 are angled

inward. In addition, the comparatively short retaining teeth 13 of the fixing pin 1, in the prefitting state, are directed inward toward the center longitudinal axis 11 of the fixing pin 1 to such an extent that, in the fitted state, by means of an outward deformation, they form or produce the requisite undercut relative to the underside hole bearing surface 15b of the locating hole 2.

The center shank section 1b of the fixing pin 1 expediently has a cylindrical cross section with a shank outside diameter D. The bottom insertion section 1c is locally enlarged relative to this outside diameter D. As can be seen from figs 2 and 3, this diameter enlargement is achieved by local bulges or wart-shaped prominences 18. In addition, the insertion section 1c is provided with an inclined insertion surface in the form of a bevel 19 directed inward toward the center axis 11 of the fixing pin 1 at a bevel angle α. This bevel 19 serves as an insertion aid when the fixing pin 1 is inserted via its insertion region 1c with its shank region 1b into the corresponding hole 8 of the mounting part 6. This is in particular advantageous with a center offset between the locating hole 2 of the support part 3 and the hole 8 of the mounting part 6.

In addition, the insertion section 1c of the fixing pin 1 is designed to be elastic. To this end, the insertion region 1c is provided with appropriate recesses 21 while elastic push-in arms 20 are formed. Instead of the recesses 21 in the shape of an arc of a circle, said recesses 21 may also have other shapes. The bevel 19 and the spring action of the insertion section 1c of the spring pin 1 have an advantageous effect during the insertion of the spring pin 1 into the hole 8 of the substructure or of the machine part 6.

When the fixing pin 1 is being fitted, it is inserted with its insertion section 1c into the locating hole 2 of the support part 3. The comparatively short retaining teeth 13 are bent radially inward by pressure on the top side of the fixing pin

1 in the pin longitudinal direction 10. In the process, the fixing pin 1 passes through the locating hole 2 to the maximum extent until the retaining lugs 14 of the comparatively long retaining teeth 12 bear against the top hole seating surface 15a of the hole edge 15. In this end position, the comparatively short retaining teeth 13 spring back and engage below or behind the support part 3 on the bottom hole edge 15 in the region of the hole bearing surface 15b. A captive arrangement of the fixing pin 1 in the support part 3 like a snap connection is thus provided for, in interaction with the comparatively long retaining teeth 12. The alternative fastening of the fixing pin 1, in which the undercut is produced by bending out the short retaining teeth 13 after insertion of the fixing pin 1 into the locating hole 2, e.g. by a pressing operation, is shown in figs 9 and 10.

In order to compensate for a possible center offset between the hole 8 of the substructure or of the mounting part 6 and the corresponding locating hole 2 of the support part 3, the fixing pin 1 can be inserted in the locating hole 2 of the support part 3 with a certain radial clearance 22 (figures 6 to 8). Firm seating of the fixing pin 1 in the support part 3 is then made possible by the circumferential diameter B in the top retaining section 1a and below the retaining lugs 14, there, of the long retaining teeth 12 being greater than the hole diameter A of the locating hole 2. As a result, the long, elastic retaining teeth 12 always rest with a certain spring prestress in the locating hole 2. The comparatively long retaining teeth 12 are therefore designed with a corresponding oversize relative to the shank diameter D and the hole diameter A of the locating hole 2.

In this case, the outside diameter B, indicated in fig. 2, of the end top retaining section 1a of the fixing pin 1 is expediently greater than or equal to the hole or opening diameter A of the locating hole 2 in the support part 3 (fig. 7). This means that the comparatively long retaining teeth 12, at the end, partly bear with their outside against the hole

edge 15, i.e. against the inner hole wall 23 (fig. 7) of the locating hole 2.

As illustrated with the aid of fig. 8, which shows a long retaining tooth 12 released from the hole edge 15 of the locating hole 2, forces occur between the retaining teeth 12 and the hole edge 15 as a result of the spring action of said retaining teeth 12. The indicated axial component F_{ax} of the spring or restoring force F produced by the long retaining teeth 12 being bent out thus leads to a situation in which the short retaining teeth 13 come to bear on the underside against the hole edge 15 and at this location against the hole bearing surface 15b irrespective of the thickness d of the support part. Tolerances of the thickness d of the support part are thereby compensated for in a simple and reliable manner.

The radial component F_{rad} produces firm seating in the radial direction irrespective of the hole tolerance of the locating hole 2 and the diameter of the fixing pin 1. Furthermore, the fixing pin 1 is also centered virtually automatically in the locating hole 2 as a result. The long retaining teeth 12 are therefore bent outward preferably symmetrically to the center longitudinal axis 11 of the fixing pin 1 and at the same time are directed so as to run outward at an angle.

When the support part 3 fitted with the fixing pins 1 is put onto the substructure or the mounting part 6, the fastening between the support part 3 and the mounting part 6 is effected by pressing the fixing pins 1 into the hole 8 of the mounting part 6.

The fixing pin 1 is preferably produced by rolling a sheet-metal strip with corresponding recessing and embossment. The longitudinal slot 24 (fig. 6) which is thereby present and is continuous in the axial or pin longitudinal direction can be used for increasing the spring action of the fixing pin 1, a factor which simplifies the fitting and increases the firm seating of the fixing pin 1.

Figures 11 and 12 show the fixing pin 1 with lugs 25 which are integrally formed on the comparatively long retaining teeth 12 on both sides and which form a virtually closed ring 27 in the circumferential direction of the fixing pin 1 in its top retaining section 1a while forming slots or gaps 26. Depending on the position and width of the slots 26, the comparatively short retaining teeth 13 are at least partly overlapped in the longitudinal direction 10 by the lugs 25.

As a result of the ring 27, which is virtually closed axially at the end in the circumferential direction of the fixing pin 1, the risk of a plurality of fixing pins 1 becoming caught, e.g. during their surface treatment or during their transport in a common packing, is at least reduced.